Space Weather Technical Forecast

Issued on Saturday, 05 March 2022 at 00:46 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight Chance of G1/Minor Geomagnetic Storms this UTC weekend. Daily Chance of R1 Minor Radio Blackouts throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Low over the period, with occasional low-level C-class X-ray flares recorded at GOES 16. These events peaked with a C1.7 at 04/0043UTC from AR2960 near the southeastern limb. This group was perhaps the most noteworthy on the disc in terms of appearance, with an intermediate spot emerging, before migrating westwards to merge with the leading spot to give an Eho/Beta. Also of note were 2959 and 2957 - near centre disc in close proximity to each other - with the former showing proliferation in its trailers as its leader faded to leave a Cri/Beta, while 2957 showed proliferation around its large trailing group, ending the 24 hours a Dsi/Beta. The current cohort of sunspots was rounded out by a final pair of simple, mature and stable Hsx/Alpha groups nearing the northwestern horizon - in the form of AR2954 and 2955.

A small filament was seen to disappear from the northwestern quadrant on (for example) Cerro Tololo H-alpha imagery around 04/1500UTC, however this does not appear to have left the immediate solar environment. The main Coronal Mass Ejection (CME) activity in the 24 hours was a large but diffuse and slow far-sided event from the western solar hemisphere, seen into the UTC evening heading well south on available imagery. No Earth-directed CMEs were in evidence.

Figure 0: Cerro Tololo H-Alpha imagery of a minor disappearing filament from the northwestern quadrant around 04/1500UTC. No ejecta has been seen on coronagraphs, and it is likely that this did not leave the immediate solar environment.

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Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, was symptomatic of intermittent connection to a negative polarity high speed stream, thought to be that from CH61/-, with the phi angle accordingly mainly negative (towards the sun), but very variable within this sector and with occasional dalliance with positive. The solar wind speed was volatile in the 24 hours between around 425 and 475km/s, while the density gradually fell from low double figures to within more typical single figures ppcc. The IMF peaked early in the period at 9nT before gradually falling, while the north-south component inherited a lot of the variability seen in other measures with frequent changes between +7 and -6nT.

The net result of these solar wind measures was provisionally Quiet to Unsettled Kp, with a peak of 3+ in the 00-03UTC interval.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) measured at GOES 16 was at Background levels.

The high energy electron flux (greater than 2 MeV) ranged between Normal Background and Moderate levels. The corresponding 24-hour integrated electron fluence remained well below the Active (1e8 integrated pfu) threshold, with a slight decline evident. The 05/0000 UTC observation was 3.65e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is Expected to be Low, with further occasional C-class flares and a Chance of M-class flares. No significant regions are expected to rotate onto or leave the visible disc through the period.

Solar Wind / Geomagnetic Activity: There are two parts to the geomagnetic forecast: the current coronal hole high speed stream(s) from CH61 and CH62, which may be indistinguishable from each other; and also a possible glance from a CME emitted on 02/1739UTC in relation to the M2.0 from AR2958.

There remains a Slight Chance of G1 from the high speed stream into the UTC weekend, with this risk extending later in the weekend as a result of the uncertain influence of the M2.0-associated CME. Activity should wane into the new working week, becoming most reliably Quiet by day four, Tuesday 08 March.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at Background levels.

The high energy electron flux is expected to be attenuated slightly over the current UTC weekend, the result of geomagnetic activity from CH61 and CH62, followed by possible further influence should the 02 March CME materialise. These features' geomagnetic activity should be waning into the new working week, resulting in a slight rise in fluence, with the risk peaking for the four-day period as a whole, but perhaps most likely remaining below Active even here.

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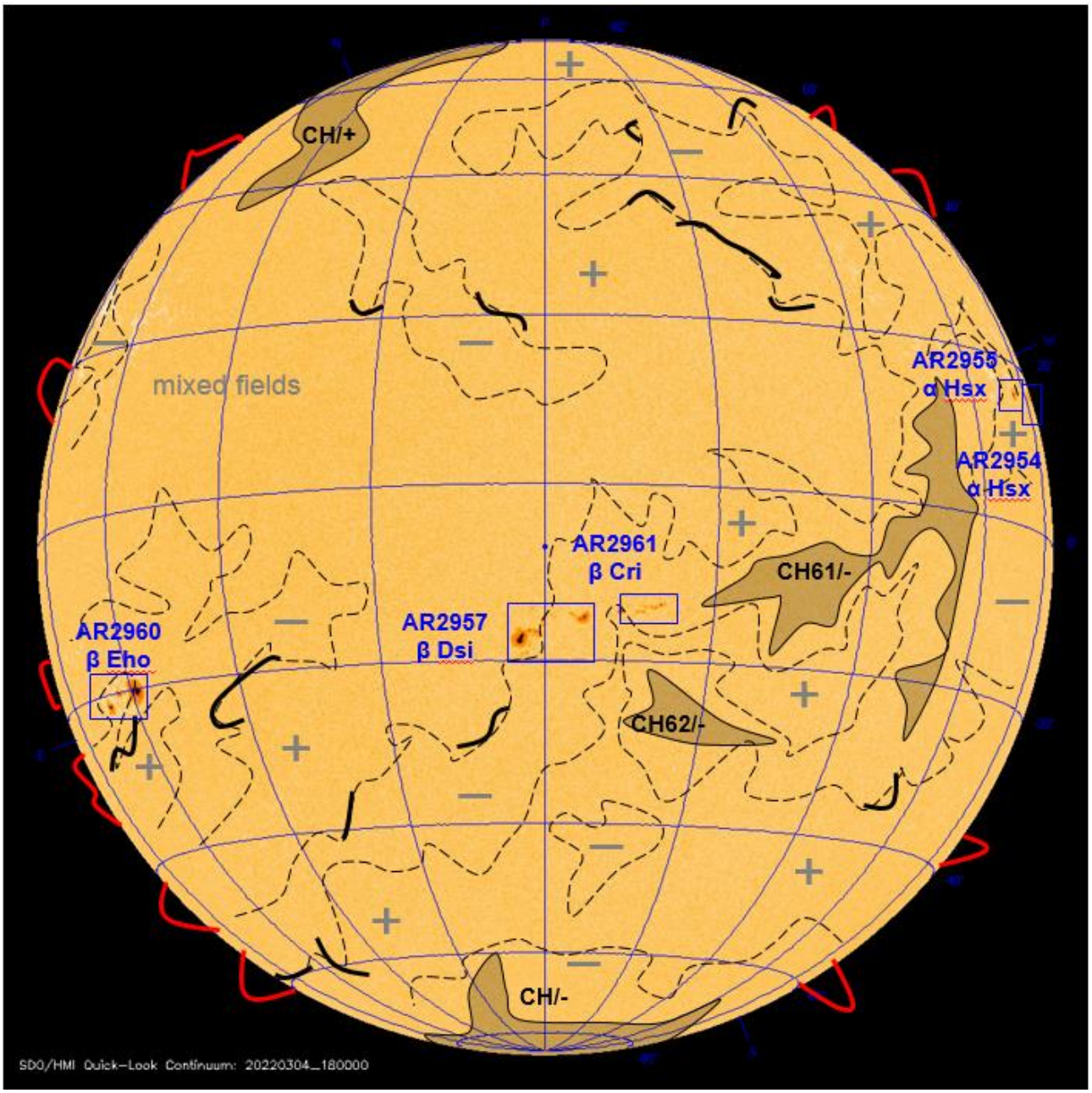
Figure 1. Solar Analysis Valid 04/1800UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are two main aspects of the geomagnetic forecast - firstly the current high speed stream from CH61, possibly indistinguishable from any following contribution from CH62; and secondly possible marginal effects from the 02/1739UTC M2.0 CME that should mainly pass behind the Earth in the track of its orbit.

CH61 and CH62's tenuous appearance on the disc appears to be being borne out in the character of the connection to the current fast wind, with a very erratic trace in solar wind speed at L1. Current slightly elevated winds should represent the peak from this event, which should last through the upcoming UTC weekend, before beginning to wane into the new working week. Being near the vernal equinox, these negative coronal hole features should make G1/Minor geomagnetic storms possible, although the prospects of this should fall as the weekend progresses.

Modelling of the 02/1739UTC M2.0 CME revealed some MOSWOC Enlil ensemble members with 'hits' on or after 06/1200UTC, however closer inspection of their perturbations suggests that these are not favoured scenarios (e.g. excessively wide CME cone angles - compared to observed imagery). In any case, with this CME thought to be more fully aimed at STEREO A, this satellite should provide some kind of forewarning as to its likely character should it materialise at Earth.

The chances of G1 are now Slight and fall through the period - the major contributors of CH61/62 should start the weekend, and any contribution from the CME should follow, with the most reliably Quiet conditions then arriving by Tuesday 08 March.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	10	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
2022-03-03 06:01	Possible partial	AR2958	NE Quadrant N05E039	270km/s	After 06/1200UTC	Mainly behind Earth in orbit, low confidence in glance.

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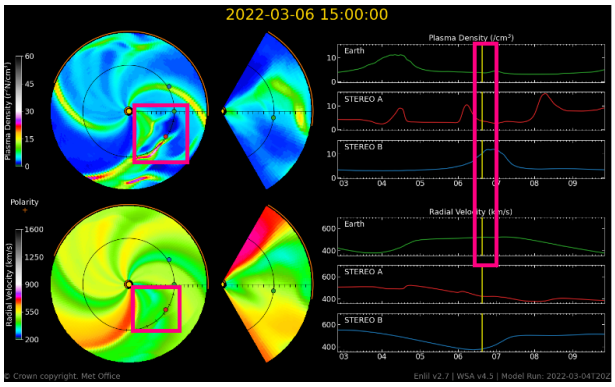
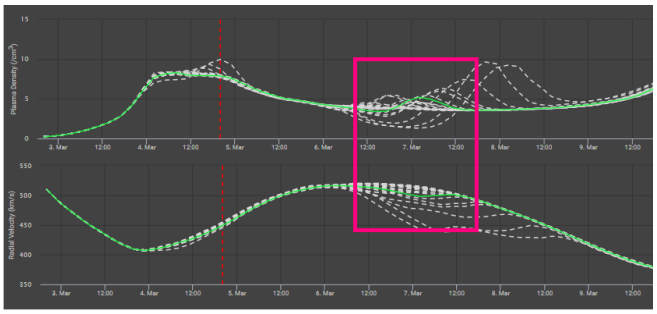
Figure 2: Latest MOSWOC Enlil run and ensemble, showing the favoured deterministic run as carrying the potential for a slight glancing blow after 06/1200UTC.





Radio Blackouts - X-Ray Flares:

Barring significant development, the contribution to X-ray flare risk from the current crop of front-sided sunspots is expected to remain largely unchanged in the four-day period, with no new returning regions, and the only spots to leave being the unipolar pair of AR2954 and 2955.

Of the three bipolar regions, AR2960 in the southeast appears to be the most active, although perhaps not to the degree that a growing trend in an Eho/Beta may suggest. Largely as a result of this region's contributions, the daily risk of C-class flares is rated at 80-90% throughout, with M-class a flat 20%. Although marginally less potent in their raw classifications, AR2961 and AR2957's presence near centre-disc will need to be monitored for their CME potential, should they flare.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**R1-R2 M Class**	No	20	20	20	20
Very Active	**R3 to R5 X Class**	No	1	1	1	1

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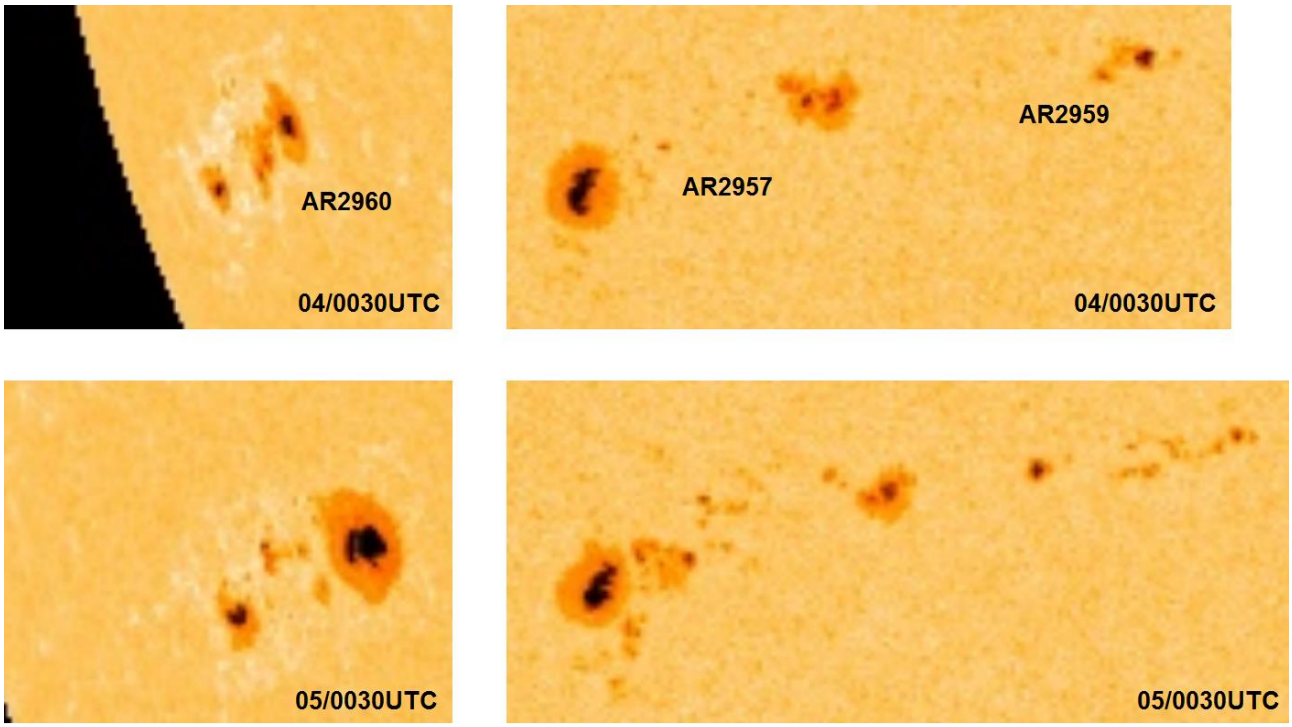
Figure 3: Evolution of the three magnetically bipolar sunspot groups on the sun in HMIIF imagery, 24 hours apart. All sunspots can be seen to have grown.



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (10MeV) measured at GOES 16 is currently at Background levels. The slightly increasing trend in the probabilities is the result of the centre-disc sunspots' nominal potential to produce S1+ events should they flare as they continue westward into slightly more geo-effective positions.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	2	2
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) has been at Normal Background to Moderate levels during the past 24 hours.

The high energy electron flux is expected to be attenuated slightly over the current UTC weekend, the result of geomagnetic activity from CH61 and CH62, followed by possible further influence should the 02 March CME materialise. These features' geomagnetic activity should be waning into the new working week, resulting in a slight rise in fluence, with the risk peaking for the four-day period as a whole, but perhaps most likely remaining below Active even here.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	5	10	25	30
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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